

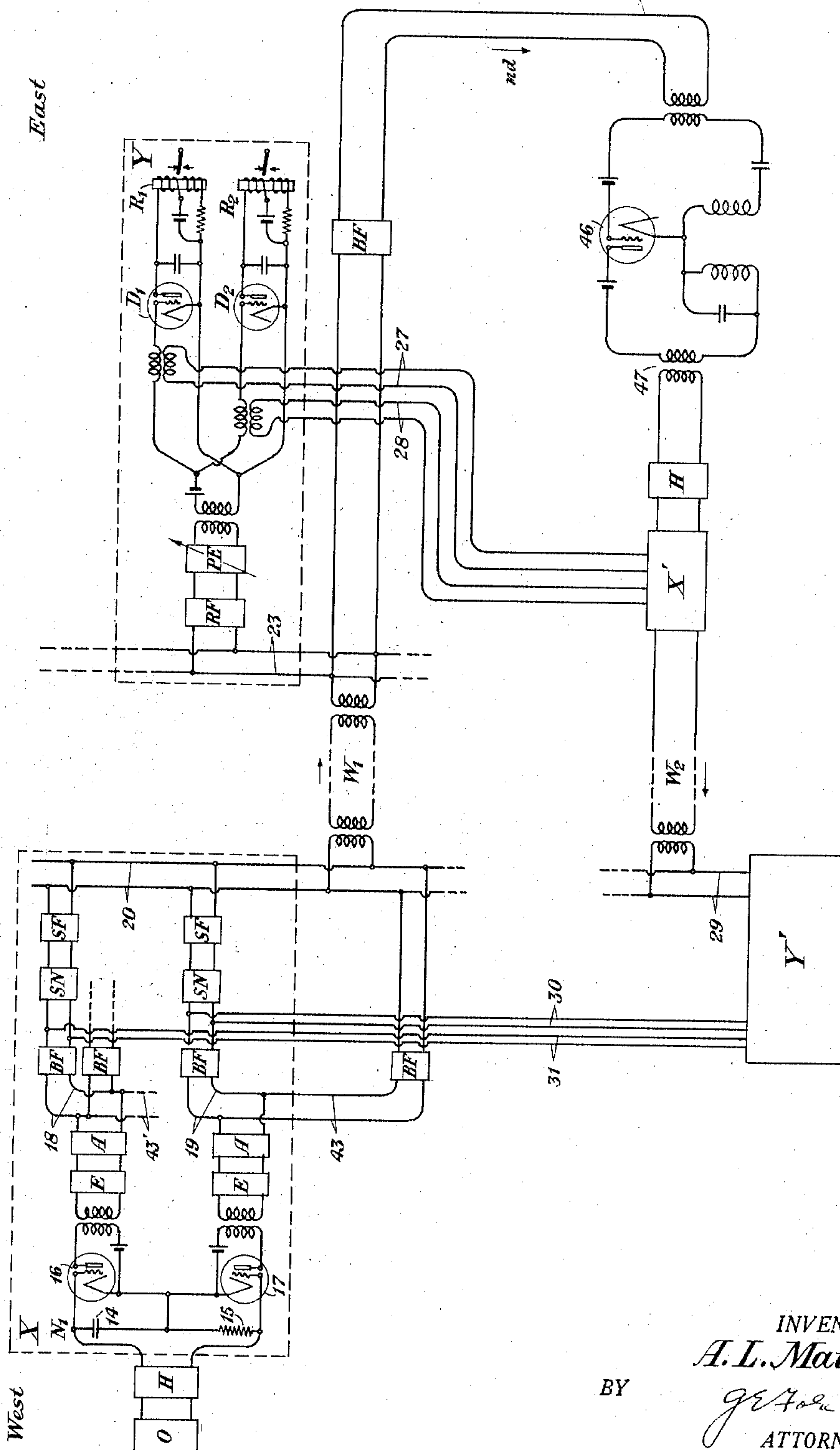
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SYSTEM OF SYNCHRONIZING SIGNALING APPARATUS

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SYSTEM OF SYNCHRONIZING SIGNALING APPARATUS.

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An object of my invention is to provide a new and improved system of synchronizing apparatus at points between which an electrical transmission is effected. Another object of my invention is to provide for proper synchronous relation of the currents in the various parts of an electric signaling system. Another object is to provide for synchronizing by currents of suitable frequency, more particularly to synchronize relatively low frequency apparatus by transmission of higher frequency currents. Still another object is to govern the frequency of a vacuum tube oscillator by impressing a current of harmonic frequency thereon. These and various other objects of my invention will become apparent on consideration of an embodiment of the invention which I have chosen for illustration and which I now present by way of example in the following specification taken with the accompanying drawing. It will be understood that the invention is defined in the appended claims and that the following description relates more particularly to the example shown in the drawing.

The drawing is a diagram showing two stations "East" and "West" with two-way transmission between them.

At station "West" there is a vacuum tube oscillation generator O which delivers current of a certain fundamental frequency to the distorter or harmonic generator H, from which a composite current with the fundamental and harmonics goes to the phase splitter N₁. I refer to these fundamental and harmonics as components.

The phase splitter N₁ comprising the condenser 14 and resistance 15 splits each of these simple components into two phases 90° apart, impressing the corresponding electromotive forces across the filament and grid of the respective vacuum tubes 16 and 17. Since these tubes draw substantially no current from the input circuits, there will be substantially no reaction on the phase splitter, and the output currents from the vacuum tubes 16 and 17 will be in the proper 90° relation for the two components of each of the component frequencies, the fundamental and the odd harmonics.

The output currents from the vacuum tubes 16 and 17 go to respective attenuation

equalizers E which bring the different frequency components to a desired intensity relation. From there the currents go to respective amplifiers A and are put on the respective conductor pairs 18 and 19 to which band filters BF are connected in multiple. Each band filter BF passes only one of the harmonic frequencies.

Each harmonic component passed by a respective band filter goes to a respective sending network SN controlled by a key or equivalent device. The signal wave trains from each sending net SN go through a respective band filter SF and thence in multiple to the common conductor pair 20 and to the line W₁.

It will be seen that the various carrier currents on the line W₁ differ not only in frequency, being all harmonics of a single fundamental, but that for each frequency there are two components 90° apart in phase, one component put on through the conductors 18 and the other through the conductors 19. All these component currents are modified to form signals by means of the sending networks SN except that one component in one phase is appropriated for securing synchronism at the station "East"; the other phase of the same frequency is suppressed. The one component current appropriated for synchronizing is put through the conductor pair 43 to the input of a band filter BF, and its output goes on the line W₁ along with the modulated signaling currents.

At the station "East" the currents received from the line W₁ go through the conductors 23 to respective band filters RF which pass the respective frequencies. These currents then go through suitable phase adjusters PE to the respective detectors D₁ and D₂ whose output currents control the receiving polar relays R₁ and R₂. The detectors D₁ and D₂ also receive currents of the same frequency but a quarter phase apart over the conductors 27 and 28 from a source that will be pointed out presently. One of these locally generated currents corresponds in phase with one phase of signal current, and the other locally generated current corresponds in phase with the other phase of signal current, and therefore, one phase of signal current is detected

in one detector D_1 and the other in detector D_2 . For these detectors D_1 and D_2 local currents of the same frequency as the respective carrier currents and in proper phase relation are required. These are supplied over the respective circuits 27 and 28, and their generation in the proper phase relation will now be described.

The particular harmonic frequency appropriated for synchronizing and sent through the conductors 43 at station "West" may be thought of as having the frequency nd where d is the fundamental frequency and n is an integral multiplier. At the receiving station this particular harmonic will be passed through an appropriate band filter BF and over the conductors labelled nd to the input of the vacuum tube oscillator 46. The natural frequency of this oscillator 46 is, as nearly as practicable, adjusted to be equal to d , whereas the input frequency is nd . The application of the harmonic frequency nd to the input of this oscillator adjusted rather closely to the natural frequency d , forces the said oscillator to operate at precisely the frequency d .

The output from the oscillator 46 goes through the transformer 47 to the harmonic generator or distorter H. The output from the harmonic generator H goes to the apparatus designated X' , which corresponds to the apparatus X at station "West" which has already been described in detail. Thus, while the line W_1 is available for transmission from "West" to "East" the line W_2 serves for transmission from "East" to "West" and reception at "West" over the last-mentioned line is similar to that already described for reception at "East" over the line W_1 .

The apparatus at Y' in the drawing cor-

responds to that indicated as Y, and already described in detail.

This application is a division of my application Serial No. 11,801, filed February 26, 1925, and renewed at or shortly before the time of filing the present application.

I claim:

1. The method of synchronizing a relatively low frequency vacuum tube oscillator at a distance by transmitting and applying thereto a current of harmonic frequency.

2. The method of synchronizing two vacuum tube oscillators of approximately the same relatively low natural frequency, which consists in deriving a harmonic current from one of said oscillators and transmitting it and applying it to the other of said oscillators.

3. In a communication system, comprising a relatively low frequency vacuum tube oscillator at the sending end and a similar oscillator of approximately the same natural frequency at the receiving end, the method of synchronizing them which consists in transmitting a current of harmonic frequency and applying it to the oscillator at the receiving end and thereby forcing it into synchronism at the said relatively low frequency.

4. In a system comprising two widely separated vacuum tube oscillators naturally tuned nearly together, the method of forcing one of them to the frequency of the other, which consists in transmitting from said other oscillator a current of harmonic frequency and applying it to the said one oscillator.

In testimony whereof, I have signed my name to this specification this 19th day of May 1927.

ANDREW L. MATTE.